

WHAT IS CLAIMED IS:

1. A switch controller inside a switch device capable of easing network congestion, the switch controller has a plurality of ports and the switch device further includes a shared buffer and a plurality of physical layer devices (PHY), the shared  
5 buffer can be divided into a plurality of buffering units, the switch controller comprising:

a buffer control device coupled to the shared buffer for assigning and releasing the buffering units;

a plurality of port control devices coupled to the physical layer devices and the  
10 buffer control device, wherein each port control device has a one-to-one correspondence with the ports, the port control device that corresponds to a source port receives a network packet and then sends the packet to at least one of the buffering unit(s) for storage;

a forwarding control device coupled to the port control devices, and a target port  
15 of the packet is determined according to a header of the network packet; and

a queue control device coupled to the port control devices and the buffer control device, wherein the queue control device further includes a plurality of output queues, each output queue has a one-to-one correspondence with the port control devices, each output queue has a number of reserved buffering units, and the buffering unit for storing  
20 the packets is linked to the output queue corresponding to the port control device at a target port;

wherein the source port triggers or terminates a congestion mode to control the number of free buffering units in response to the number of reserved buffering units in the output queue.

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2. The switch controller of claim 1, wherein a  $k^{\text{th}}$  port is the target port and a plurality of parameters are defined as follows:

$Q[k]$  : length of the output queue of the  $k^{\text{th}}$  port;

$R_{\text{max}}$  : number of maximum buffering units reserved for each port;

5  $R[k]$  : number of buffering units reserved for the  $k^{\text{th}}$  port,

$R[k] = 0$  when  $R_{\text{max}} \leq Q[k]$ ; and

$R[k] = R_{\text{max}} - Q[k]$  when  $R_{\text{max}} > Q[k]$ .

$\Psi$  : the total number of reserved buffering units, i.e.,  $\Psi = \sum_{k=0}^n R[k]$ ;

$\Phi$  : number of free buffering units;

10  $C$  : the number of reserved buffering units in the virtual free space;

$\Omega$  : number of virtual free buffers,

when  $\Phi \leq C$ ,  $\Omega = 0$ , and when  $\Phi > C$ ,  $\Omega = \Phi - C$ ;

$W$  : minimum number of reserved virtual buffering unit;

15 wherein the congestion control mode is triggered when  $\Omega \leq \max \{ \Psi, W \}$  and  $R[k] = 0$ .

3. The switch controller of claim 2, wherein the number of reserved buffering unit in virtual free space  $C$  is 10, and the lowest number of reserved buffering units in virtual free space  $W$  is 28.

20 4. The switch controller of claim 1, wherein a  $k^{\text{th}}$  port is the target port and a plurality of parameters are defined as follows:

$Q[k]$  : the output queue length of the  $k^{\text{th}}$  port;

$R_{\text{max}}$  : the greatest number of buffering units reserved by the port;

$R[k]$  : the number of buffering units reserved by the  $k^{\text{th}}$  port,

when  $R_{\text{max}} \leq Q[k]$ ,  $R[k] = 0$ , and

when  $R_{\max} > Q[k]$ ,  $R[k] = R_{\max} - Q[k]$ ;

wherein the congestion control mode for the  $k_{th}$  port is triggered when any of the other ports has already triggered a congestion control mode and  $R[k] = 0$ .

5. The switch controller of claim 1, wherein each port control device includes:

5 a receive medium access control device coupled to one of the physical layer devices, wherein the received medium access control device inspects any incoming network packet for errors, if no errors is found, the packet is accepted, otherwise the packet is returned;

10 a receive control device coupled to the receive medium access control device, the queue control device and the buffer control device, the receive control device issues requests to the buffer control device to assign at least one buffering units(s) for storing the packet and signals the queue control device to request queuing to the corresponding output queue;

15 an output control device, coupled to the queue control device and the buffer control device for outputting the packet from the output queue, and releasing the buffering units after the buffer control unit has sent out the packet;

20 a transmission medium access control device coupled to the output control device and one of the physical layer devices for outputting the packet to the physical layer device, and when the congestion control mode is triggered, the transmission medium access control device within the port control device that corresponds to the source port sends out a control signal to execute the congestion control operation; and

a physical layer control device coupled to the transmission medium access control device and one of the physical layer devices, receiving a plurality of state signals from an external network device to select a proper congestion control mode.

6. The switch controller of claim 5, wherein the controller further includes a CPU port capable of connecting with a CPU for a two-way data transmission via an ISA/IDE interface.

7. The switch controller of claim 5, wherein the congestion control mode  
5 includes a backpressure control mode, a drop control mode and a flow control mode.

8. The switch controller of claim 7, wherein the backpressure control mode is selected when the external network device operates in a half-duplex mode without flow control capability.

9. The switch controller of claim 7, wherein the drop control mode is selected  
10 when the external network device operates in a full-duplex mode but without flow control capability.

10. The switch controller of claim 7, wherein the flow control mode is selected when the external network device operates in a full-duplex mode with flow control capability.

11. A method for easing data transmission congestion in a switch device having  
15 a plurality of ports, the switchdevice includes a shared buffer capable of dividing into a plurality of buffering units, comprising the steps of:

providing a plurality of output queues, wherein the output queues have a one-to-one correspondence with the ports, and each output queue has a number of reserved  
20 buffering units;

assigning the buffering units in the shared buffer;

receiving a packet from a source port and storing the packet in an assigned buffering unit;

determining the target port of a network packet according to a header of the packet;

linking buffering unit containing the stored network packet to the output queue that corresponds to the target port; and

5       controlling free buffering units according to a number of reserved buffering units in the output queue and a triggering or a terminating condition of the source port.

12. The method of claim 11, wherein a  $k^{\text{th}}$  port is the target port and a plurality of parameters are defined as follows:

10        $Q[k]$  : length of the output queue of the  $k^{\text{th}}$  port;  
 $R_{\text{max}}$  : number of maximum buffering units reserved for each port;  
 $R[k]$  : number of buffering units reserved for the  $k^{\text{th}}$  port,  
 $R[k] = 0$  when  $R_{\text{max}} \leq Q[k]$ ; and  
 $R[k] = R_{\text{max}} - Q[k]$  when  $R_{\text{max}} > Q[k]$   
 $\Psi$  : the total number of reserved buffering units, i.e.,  $\Psi = \sum_{k=0}^n R[k]$ ;  
15        $\Phi$  : number of free buffering units;  
 $C$  : number of reserved buffering units in the virtual free space;  
 $\Omega$  : number of virtual free buffers,  
when  $\Phi \leq C$ ,  $\Omega = 0$ , and when  $\Phi > C$ ,  $\Omega = \Phi - C$ ;  
 $W$  : minimum number of reserved virtual buffering unit;  
20       wherein a congestion control mode is triggered when  $\Omega \leq \max \{ \Psi ,$   
 $W \}$  and  $R[k] = 0$ .

13. The method of claim 12, wherein the number of reserved buffering unit in virtual free space  $C$  is 10, and the minimum number of reserved buffering units in virtual free space  $W$  is 28.

14. The method of claim 11, wherein a  $k^{\text{th}}$  port is the target port and a plurality of parameters are defined as follows:

$Q[k]$  : length of the output queue of the  $k^{\text{th}}$  port;

$R_{\text{max}}$  : number of maximum buffering units reserved by the port;

5  $R[k]$  : number of buffering units reserved by the  $k^{\text{th}}$  port,

$R[k] = 0$  when  $R_{\text{max}} \leq Q[k]$ ; and

$R[k] = R_{\text{max}} - Q[k]$  when  $R_{\text{max}} > Q[k]$ ;

wherein a congestion control mode is triggered when any one of the port has already triggered a congestion control mode and  $R[k] = 0$ .

10 15. The method of claim 11, wherein a plurality of parameters are defined as follows:

$\Phi$  : the number of free (unassigned) buffering units;

$C$  : the number of reserved buffering units in the virtual free space;

$\Omega$  : the number of virtual free buffers,

15 when  $\Phi \leq C$ ,  $\Omega = 0$ , and when  $\Phi > C$ ,  $\Omega = \Phi - C$ ;

when  $\Phi = 0$ , the congestion control mode is triggered.

16. The method of claim 11, further including following steps:

outputting the network packet from the target port;

releasing the buffering unit after the network packet is output;

20 selecting the type of congestion control in response to an external network device.

17. The method of claim 16, wherein the congestion control mode includes a backpressure control mode, a drop control mode and a flow control mode.

| Variable            | Mean | SD   | Min | Max  | Skewness | Kurtosis | Normality |
|---------------------|------|------|-----|------|----------|----------|-----------|
| Age                 | 35.2 | 12.5 | 18  | 65   | -0.1     | 3.2      | 0.98      |
| Gender              | 0.5  | 0.5  | 0   | 1    | 0.0      | 0.0      | 0.99      |
| Education           | 12.5 | 2.5  | 8   | 16   | -0.2     | 3.5      | 0.97      |
| Income              | 1500 | 500  | 500 | 3000 | 0.5      | 4.0      | 0.95      |
| Health              | 2.5  | 1.0  | 1   | 4    | -0.5     | 3.8      | 0.96      |
| Stress              | 3.0  | 1.5  | 1   | 5    | 0.2      | 3.3      | 0.98      |
| Depression          | 2.0  | 1.0  | 1   | 4    | -0.3     | 3.6      | 0.97      |
| Life Satisfaction   | 3.5  | 1.0  | 1   | 5    | -0.1     | 3.2      | 0.98      |
| Resilience          | 2.5  | 1.0  | 1   | 4    | -0.2     | 3.5      | 0.97      |
| Optimism            | 3.0  | 1.0  | 1   | 4    | -0.1     | 3.2      | 0.98      |
| Self-Esteem         | 2.5  | 1.0  | 1   | 4    | -0.2     | 3.5      | 0.97      |
| Life Events         | 1.5  | 1.0  | 0   | 3    | 0.1      | 3.1      | 0.99      |
| Life Events Squared | 0.5  | 0.5  | 0   | 1    | 0.0      | 0.0      | 0.99      |

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external network device operates in a full-duplex mode with flow control capability.